What is claimed is:

Sub A1

1. A system for simulating movement of a medical device in a body cavity or lumen of a patient, comprising:

   (a) a medical device comprising a first end for manipulation by a user and a portion comprising a second end insertable into a simulated body cavity or body lumen in a manikin;

   (b) a manikin comprising an interface for receiving the portion comprising the second end and for interfacing with a simulated body cavity or lumen within the manikin, wherein the interface comprises a directional force feedback mechanism for exerting a directional force on the medical device in response to a feedback signal received by the force feedback mechanism.

2. The system according to claim 1, wherein the directional force feedback mechanism provides resistance to forward motion but enables free reverse motion in response to the feedback signal.

3. The system according to claim 1, wherein the directional force feedback mechanism comprises a rolling element coupled to the portion of the device comprising the second end and wherein an internal surface of the simulated cavity or lumen in the manikin comprises an oblique slot for receiving the rolling element.

4. The system according to claim 3, wherein, in response to a feedback signal, forward movement of the second end causes the rolling element to be received by the slot, thereby causing resistance to further forward motion.

5. The system according to claim 4, wherein a motor controls movement of the rolling element.

6. The system according to claim 1, further comprising a tactile feedback mechanism.

7. The system according to claim 6, wherein the tactile feedback mechanism provides continuous vibrational feedback to a user holding the medical device.

8. The system according to claim 8, wherein continuous vibrational feedback is provided through a continuously rotating motor in communication with the portion of the device comprising the second end.

9. The system according to claim 1, wherein a position of at least the second end of the medical device relative to the manikin is continuously tracked.

10. The system according to claim 9, wherein the medical device comprises an encoder for tracking the translation of the device and an encoder for tracking the rotation of the device.

11. The system according to claim 9, wherein the system further comprises a tracking unit comprising a light source, a signal processing circuit, and one or more optical sensors, wherein the tracking unit is placed within the interface in optical communication with the device when it is inserted into the cavity or lumen.

12. The system according to claim 11, wherein light from the light source reflects on the device when inserted and wherein the reflected light is received by the one or more optical sensors.

13. The system according to claim 12, wherein changes in reflected light received by the one or more sensors is detected by the system, and wherein, in response to this detection, the system simulates movement of the device in real-time on the user display.

14. The system according to claim 12, wherein two optical sensors are provided which are perpendicular to one another.

15. The system according to claim 12, wherein the tracking unit is configured in the form of a rail along which the device can move.

16. The system according to claim 10, wherein one or more additional medical devices comprising a first end for manipulation by a user and a portion comprising a second end for insertion into the simulated body cavity or body lumen, are inserted into the interface and wherein the position of each medical device is independently monitored.

17. The system according to claim 16, wherein the one or more medical devices are selected from the group consisting of a catheter, guidewire, endoscope, laparoscope, bronchoscope, stent, coil, balloon, a balloon-inflating device, a surgical tool, a vascular occlusion device, optical probe, a drug delivery device, and combinations thereof.

18. The system according to claim 1, further comprising a table for placing the manikin thereon, wherein the table comprises a processor connectable to the network.

19. The system according to claim 18, wherein the system further comprises at least one first user device connectable to the network, the first user device comprising a first display interface for displaying a three-dimensional representation of a simulated body cavity or lumen of a patient.

20. The system according to claim 19, wherein the first display interface further displays a three-dimensional representation of a medical device corresponding to a medical device which is interfaced with the manikin and wherein the system simulates on the display the movement of the medical device within the simulated body cavity or lumen of the manikin in real-time when a first user manipulates the medical device interfaced with the manikin.

20. The system according to claim 19, further comprising a simulated scanning display for displaying a two-dimensional image of the simulated body cavity or lumen.

21. Sub A3 The system according to claim 20, wherein the simulated scanning display is part of a simulated scanning device.

22. The system according to claim 21, wherein the simulated scanning device is simulating an x-ray imaging system.

23. The system according to claim 21, wherein the simulated scanning device and scanning display are coupled to a movable C-arm within scanning distance of the manikin.

24. The system according to claim 1, further comprising a re-configurable control panel for performing one or more of: image acquisition selection; image display; manipulating a table on which the manikin is placed; manipulating the position of a simulated scanning device relative to the manikin; and control of one or more shutter devices for limiting a field of view of a scanning device placed within scanning distance of the manikin.

25. The system according to claim 1 or 20, further comprising a monitoring station, the monitoring station comprising a second user device connectable to the network and comprising a second display interface for enabling a second user to monitor the movement of the medical device within the simulated body cavity or lumen.

26. The system according to claim 25, wherein the second display interface of the monitoring station displays selectable options enabling the second user to select or change one or more anatomical and/or physiological parameters of the simulated body cavity or lumen, and wherein the selection causes the three-dimensional image of the simulated body cavity or lumen displayed to the first user to change to reflect the changed anatomical and/or physiological parameters.

27. The system according to claim 20, wherein the system is connectable to a database of patient images and/or medical data.

28. The system according to claim 25, wherein the system is connectable to a database of patient images and/or medical data.

29. The system according to claim 27, wherein the patient images comprise images of a body cavity or lumen from a patient affected by a pathology.

30. The system according to claim 28, wherein the patient images comprise images of a body cavity or lumen from a patient affected by a pathology.

31. The system according to claim 21, further comprising at least one foot-activation switch for activating or collimating the simulated scanning device, image display or table movement

33. The system according to claim 27, wherein the first user display interface provides access to the database and wherein, in response to accessing, the system displays an image and/or medical data on the first user display interface.

34. The system according to claim 27, wherein the second user display interface provides access to the database and wherein, in response to accessing, the system displays an image and/or medical data on the second user display interface.

35. The system according to claim 33, wherein the second user display interface provides access to the database and wherein, in response to accessing, the system displays an image and/or medical data on the second user display interface.

36. The system according to claim 35, wherein the second user display interface provides a selectable option enabling a second user to display the image displayed on the second user display interface, on the first user's display interface.

37. The system according to claim 1, wherein the device is selected from the group consisting of a catheter, guidewire, endoscope, laparoscope, bronchoscope, stent, coil, balloon, a balloon-inflating device, a surgical tool, a vascular occlusion device, optical probe, a drug delivery device, and combinations thereof.

38. A syringe for simulating fluid delivery, comprising:

a housing defining a lumen comprising an opening for delivering a fluid;

a pushing element for pushing the fluid through the opening;

a friction-producing element in communication with the pushing element; and

a motor in communication with the friction-producing element and comprising a signal-receiving element,

wherein the friction-producing element causes friction between the pushing element and a surface of the lumen of the housing upon activation by the motor in response to a signal received by the signal-receiving element.

39. The syringe according to claim 38, wherein the motor, when activated, causes motion of the friction-producing element, thereby causing the friction-producing element to contact the surface of the lumen of the housing, creating friction between the pushing element and the surface of the lumen and resistance to the motion of the pushing element.

40. The syringe according to claim 38, wherein the friction-producing element comprises one or more rubber pads.

41. The syringe according to claim 40, wherein each rubber pad is coupled to an arm whose movement is controlled by the motor.

42. The syringe according to claim 41, wherein each arm is coupled to the motor through a gear attached to the motor.

43. The syringe according to claim 38, wherein the amount of friction produced by the friction-producing element is adjusted by controlling a rotation angle of the motor.

44. The system according to claim 1, further comprising the syringe of claim 38, wherein opening of the syringe is connectable to a connecting piece having a first end for receiving fluid from the opening and a second end for delivering fluid to a simulated body cavity or body lumen in the manikin.

45. A balloon-inflating device for simulating deployment of a balloon within a body cavity or lumen of a patient, comprising:

a delivery mechanism for controlling delivery of fluid through the balloon-inflating device to the balloon;

a pressure sensor for monitoring pressure of a fluid delivered to the balloon by the balloon-inflating device;

an electrical pressure meter for reading pressure determined by the pressure sensor, the electrical pressure meter being connectable to a processor and for transmitting a signal corresponding to a pressure value to the processor.

46. The system according to claim 1, further comprising the balloon-inflating device of claim 45.

47. The system according to claim 20, wherein the system simulates deformation of the body cavity or lumen by the medical device.

48. The system according to claim 20, wherein the system simulates an operation of a medical device selected from the group consisting of: a surgical procedure, inflation or deflation of a balloon, injection of a radioopaque material into the body cavity or lumen, and combinations thereof.

49. The system according to claim 20, wherein the system simulates the movement of the device within a blood vessel.

50. The system according to claim 49, wherein the blood vessel is in the brain.

51. The system according to claim 50, wherein the blood vessel is in the heart.

52. A method for simulating the movement of a medical device in the body cavity or lumen of a patient, comprising:

providing a medical device comprising a first end for manipulation by a user and a portion comprising a second end inserted into a simulated body cavity or body lumen in a manikin, wherein the simulated body cavity or lumen in the manikin comprises a directional force feedback mechanism, and

wherein, in response to a feedback signal, the directional force feedback mechanism creates resistance to forward motion of the medical device but allows free reverse motion.

53. The method according to claim 52, further comprising:

providing a system comprising:

a processor in communication with the directional force feedback mechanism, the processor connectable to the network; and

a first user device in communication with the processor, the first user device comprising a first display interface for displaying a representation of a body cavity or lumen; and for providing access to a database of three-dimensional images of body cavities and lumens from a plurality of different patients; and

enabling a user to select from the database a representation, wherein in response to the selection, the representation is displayed on the first display interface.

54. The method according to claim 52, wherein the first display interface a displays a three-dimensional representation of the medical device and wherein the system simulates the movement of the medical device within the body cavity or lumen in real-time as a first user manipulates the medical device which is interfaced with the manikin.

55. The method according to claim 52 or 53, further comprising providing a monitoring station comprising a second display interface in communication with the processor and the first display interface, and wherein the second display interface provides a second user with access to the database.

56. The method according to claim 54, wherein when a second user selects a representation from the database, the representation is displayed on both the first and second display interface.

57. The method according to claim 53, wherein the system simulates the deformation of a body cavity or lumen in response to movement of the medical device by the first user and displays the representation of the deformation on the first display interface.

58. The method according to claim 53, wherein the medical device performs an operation on the simulated body cavity or lumen and the first display interface displays a simulation of the operation.

59. The method according to claim 58, wherein the operation is inflation or deflation of a balloon within the simulated body cavity or lumen.

60. The method according to claim 58, wherein the operation is injection of a radioopaque fluid within the body cavity or lumen.

61. The method according to claim 52, wherein the device is selected from the group consisting of a catheter, guidewire, endoscope, laparoscope, bronchoscope, stent, coil, balloon, a balloon-inflating device, a surgical tool, a vascular occlusion device, an optical probe, a drug delivery device, and combinations thereof.

62. The method according to claim 54, wherein a first user inserts one or more additional medical devices into the simulated body cavity or lumen, and the movement of each medical device is independently monitored.

63. The method according to claim 52, wherein the simulated body cavity or lumen in the manikin further comprises a tactile feedback mechanism, providing continuous vibrational feedback to a first user manipulating the device.

64. A method for simulating fluid delivery into a body cavity or lumen of a patient comprising:

(a) providing a syringe for simulating fluid delivery, the syringe comprising:

a housing defining a lumen comprising an opening for delivering a fluid;

a pushing element for pushing the fluid through the opening;

a friction-producing element in communication with the pushing element; and

a motor in communication with the friction-producing element and comprising a signal-receiving element,

wherein the friction-producing element causes friction between the pushing element and a surface of the lumen in response to a signal received by the signal receiving element; and

(b) providing a signal, thereby causing friction between the pushing element and the lumen.

65. A method for simulating deployment of a balloon within a body cavity or lumen of a patient, comprising:

(a) providing a balloon-inflating device, comprising:

a delivery mechanism for controlling delivery of a fluid through the balloon-inflating device to the balloon;

a pressure sensor for monitoring pressure of a fluid delivered to the balloon by the balloon-inflating device;

an electrical pressure meter for reading pressure determined by the pressure sensor and for transmitting a signal corresponding to a pressure value to a processor;

(b) providing a system comprising:

a processor for receiving the signal, the processor connectable to the network; and

a user device comprising an interface displaying a representation of the balloon within a simulated body cavity or lumen; and

(c) delivering the fluid to the balloon; wherein deployment of the balloon in response to the delivering is displayed on the user device.

66. The method according to claim 65, wherein the fluid is air.

67. The method according to claim 65, wherein the method is used to simulate balloon angioplasty.

68. The method according to claim 65, further comprising providing the system according to claim 1, inserting a balloon catheter into the simulated body cavity or lumen to simulate navigating to a target region of the body, and simulating positioning the balloon deployment device in proximity to the balloon catheter to inflate or deflate the balloon.

69. The method according to claim 67, further comprising inserting a catheter and guidewire into the body cavity or lumen to navigate the balloon cavity to the target region.

70. The method according to claim 67, further comprising inserting a stent catheter to navigate to a target region and using the balloon to deploy the stent, thereby simulating stent deployment in the body cavity or lumen.

71. The method according to claim 68, further comprising inserting a catheter or guidewire into the body cavity or lumen to navigate the stent catheter to the target region.

72. A method for simulating coil embolization in a body cavity or lumen of a patient, comprising:

providing a catheter, guidewire and coil wire comprising a coil to navigate to a target region of the body;

providing the system according to claim 19, wherein the re-configurable control panel provides a selectable option for detaching the coil from the coil wire, and wherein selecting the selectable option triggers the release of the coil from the coil wire.

73. The method according to claim 72, wherein an electrical current triggers release of the coil from the coil wire.

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